

Synergistic research collaboration between NASA-PMM and SIATA: from data validation to risk management applications in tropical South America

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Overview

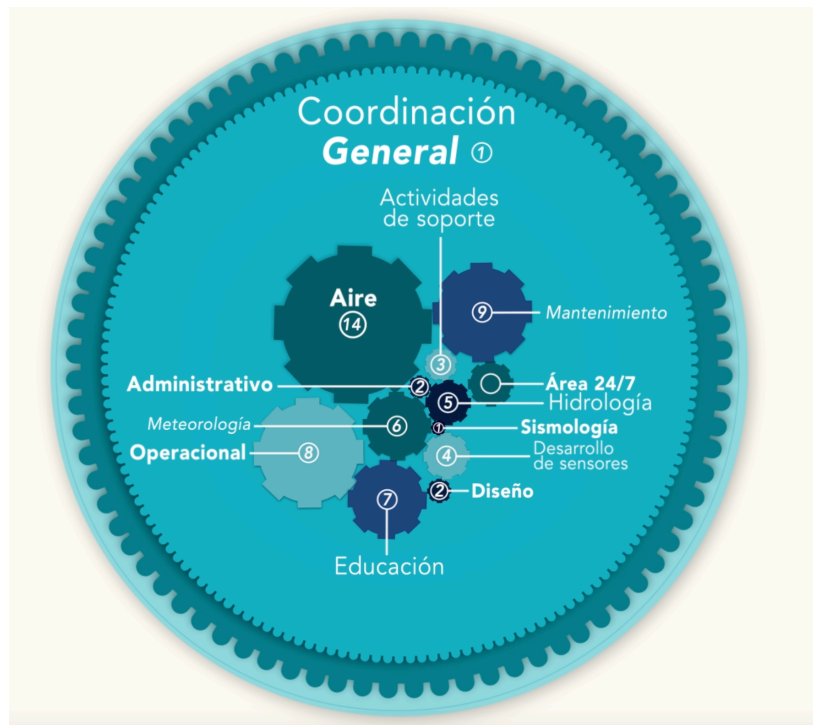
- Describe the contents of a no-cost proposal between SIATA (Early warning system of the city of Medellín, Colombia and its Metropolitan Area) to join the International Collaboration for the NASA-PMM Science Team
- Science issues to be addressed:
 - Gather, improve and validate useful data
 - Provide opportune and accurate early warning information
- Examples of science applications that are developed in SIATA

Sistema de Alerta Temprana de Medellín y el Valle de Aburrá

<http://www.siata.gov.co/>



- SIATA is a science and technology project
- The main GOALS are to **collect and provide information** (monitoring and modeling) and **education to the community and risk management institutions**, and to **provide information** to energy generation companies in the region



SIATA's Personnel is a small research group with operational (development) and research tasks

- 2 PhDs in Atmospheric Sciences
- 2 PhD Students in Atmospheric Sciences.
- 1 PhD Student in Hydrology
- 9 MS in various areas (Meteorology, Electronics, IT, Hydrology)
- 10 MS Students
- 6 Undergrad Students
- 20 Development Engineers and Field Technicians

Con el apoyo de:



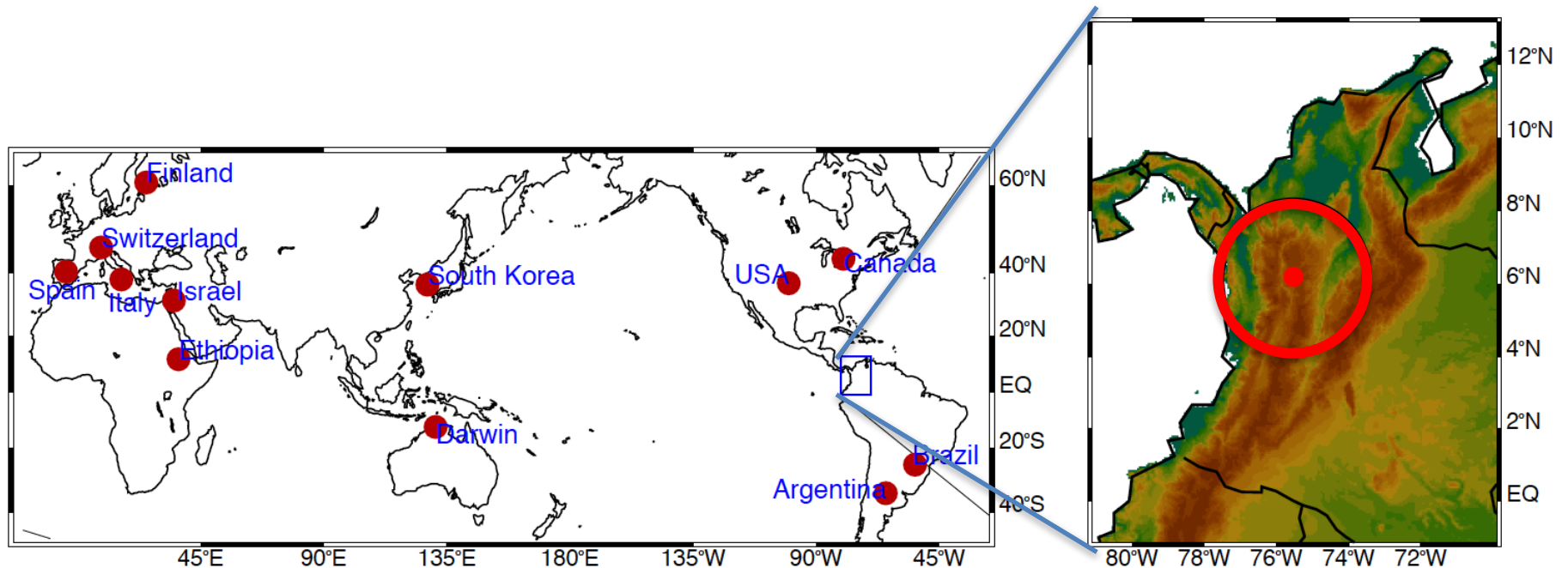
Un proyecto de:



Alcaldía de Medellín

Science Questions

There is a gap of direct measures around this region

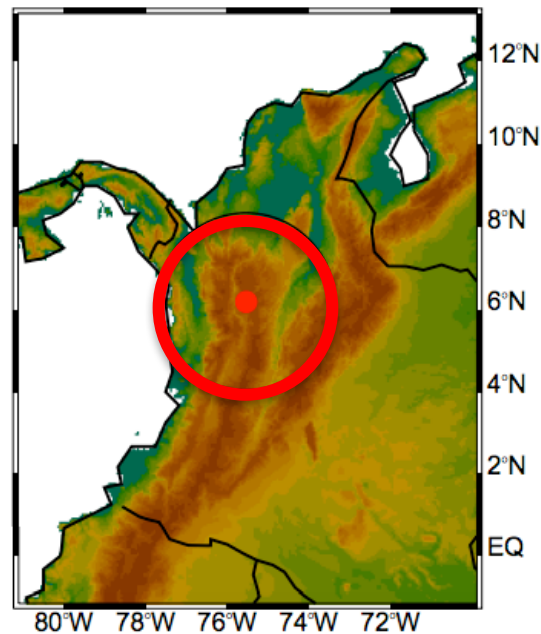


Global map showing the approximate locations of sites selected for NASA and the international collaboration program for GPM ground validation (Hou et al. 2014)

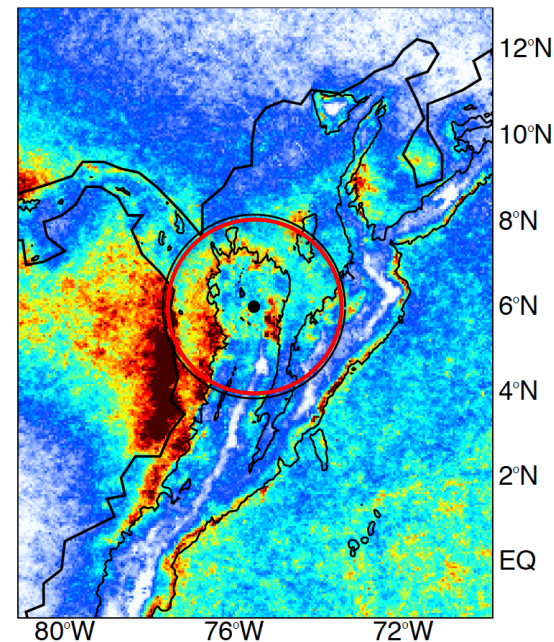
Location of the City of Medellin and the area of radar coverage

- Improve the actual ground validation network
- Fill an important gap for the collection of the weather related data over this complex tropical mountainous region

There is a need for ground validation of satellite data across the mountainous regions of the tropical Andes

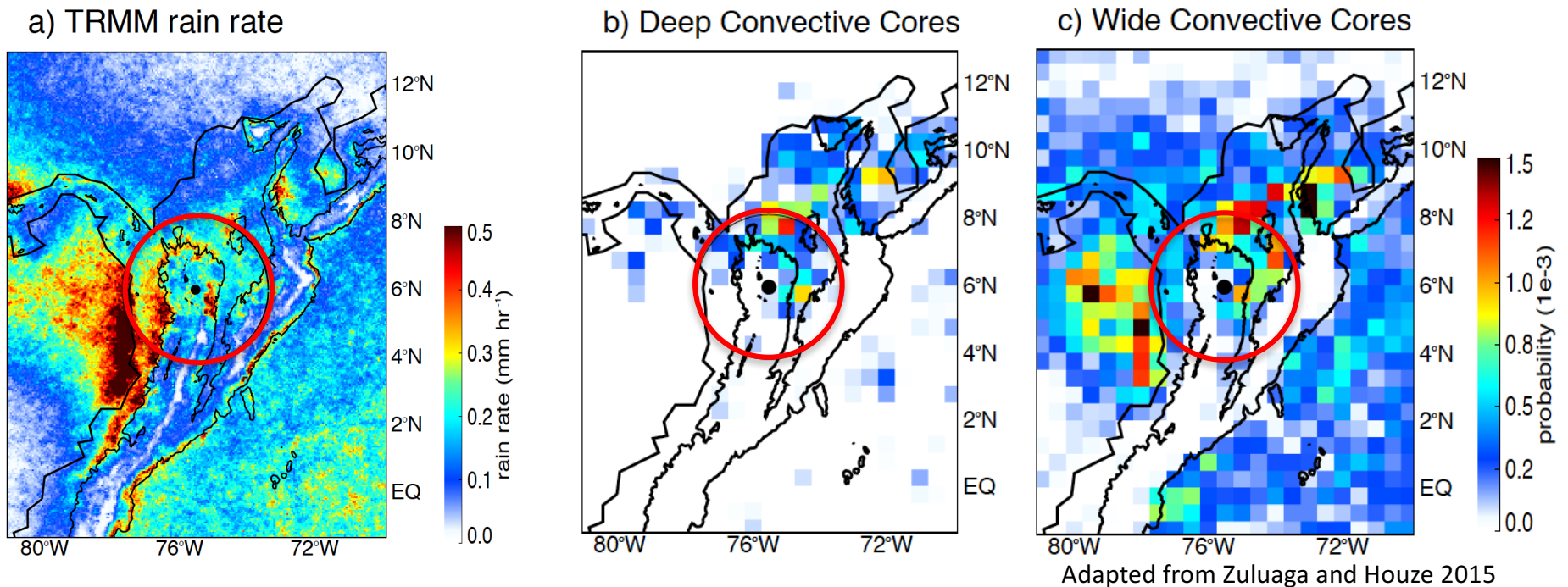


a) TRMM rain rate



- Unique region in weather related importance since it is where the ICTZ meets elevated topography (up to 4000 msl)
- Close to a region of a local maximum in precipitation

There is a need identify and characterize extreme weather across the region

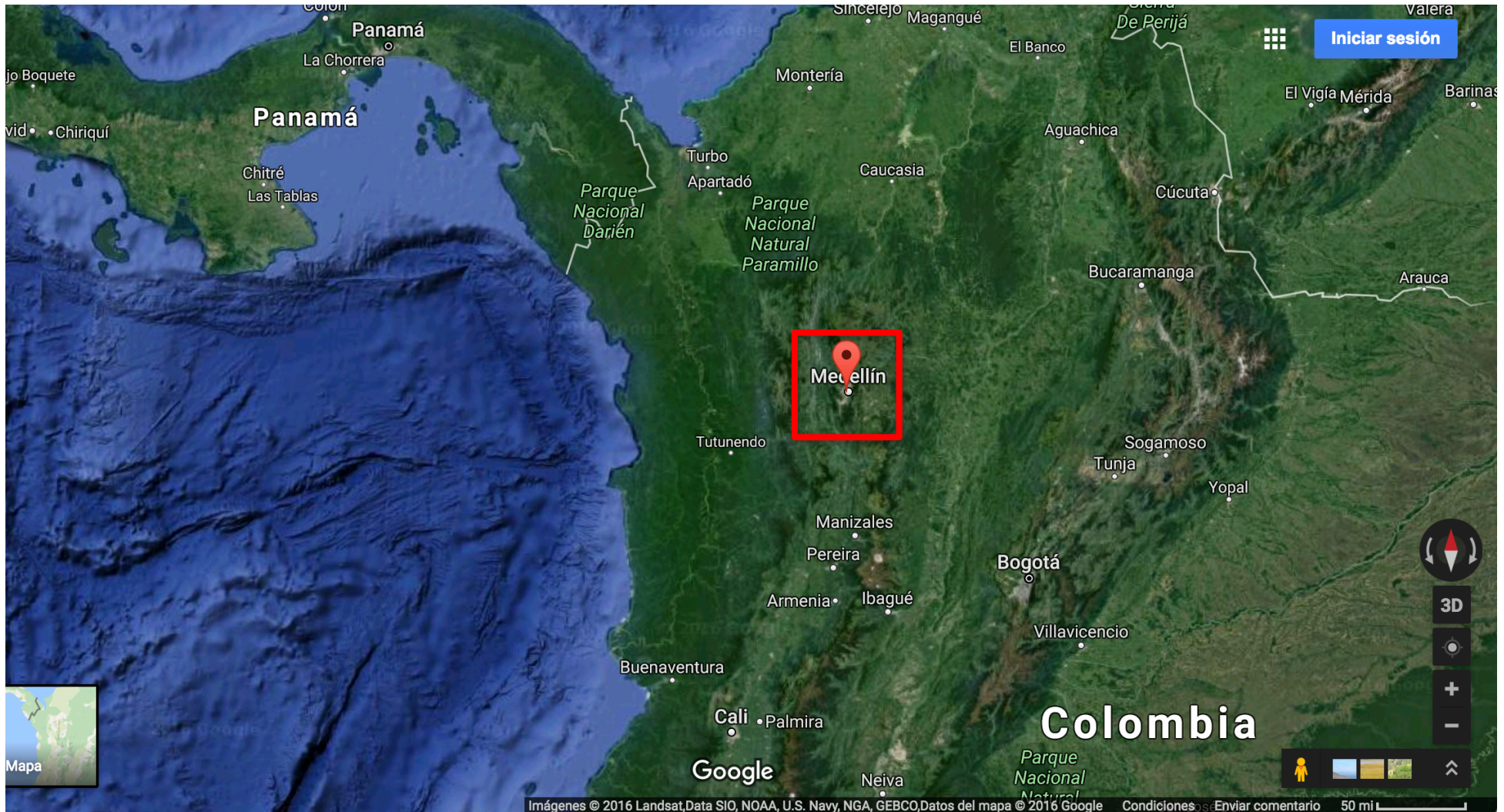


- Convective precipitative structures take special forms that are favorable to produce extreme related weather in the form of intense lightning and precipitation conducive to flash floods (Zuluaga and Houze 2015)

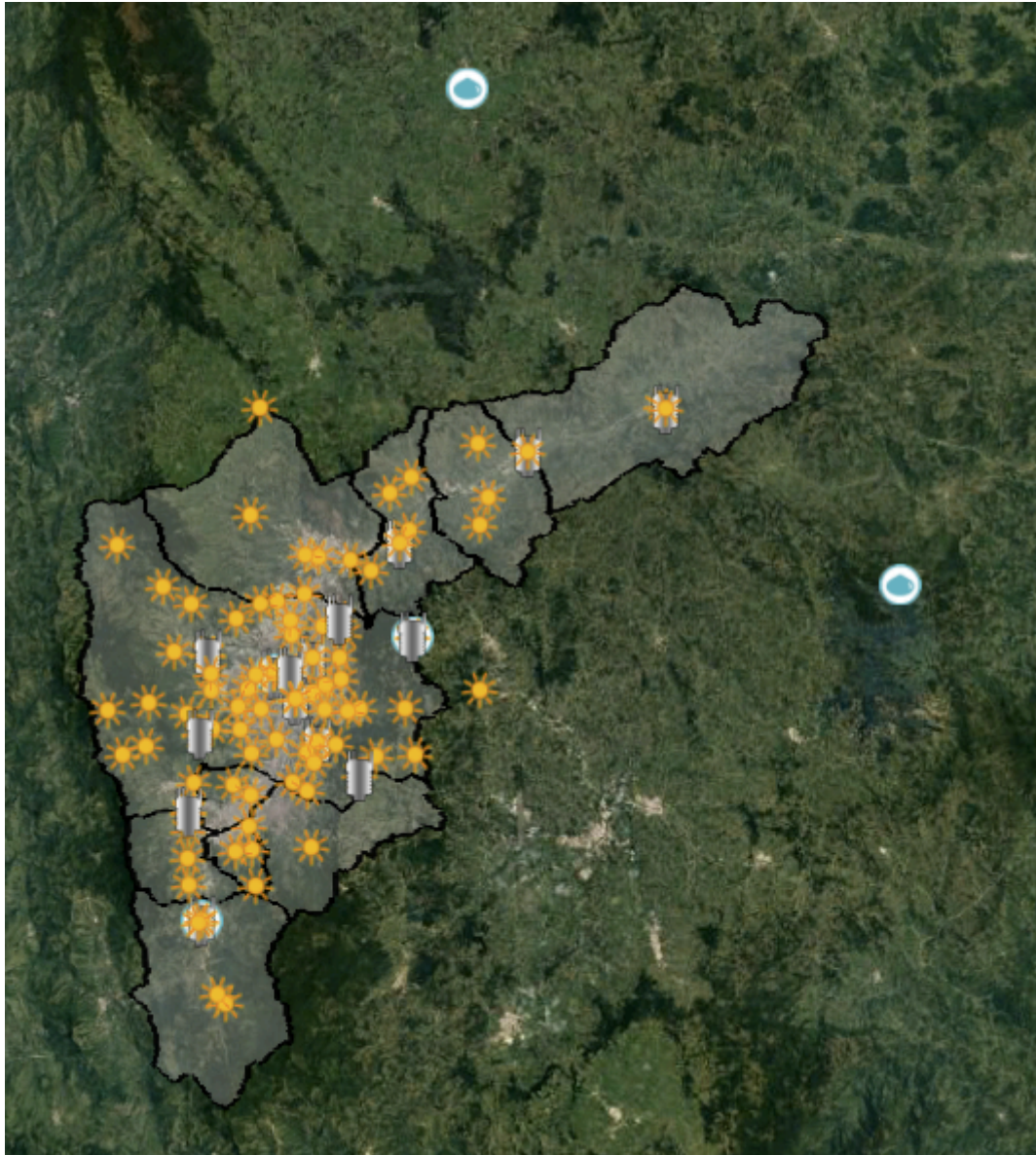
Research Goals

- Establish a formal relationship between NASA-PMM and SIATA for the exchange of weather related information
- Compare and analyze the instantaneous fields measured by the SIATA ground network, and the TRMM and GPM spaceborne sensors
- Characterize space-time variations of the convective cloud population and the physical mechanisms that produce them
- Validate and contextualize the weather observations that routinely SIATA collects with the ones collected by all the national meteorological partners in NASA-PMM ground validation program

Available Infrastructure



Available Infrastructure



83 Low-cost rain gauges

**15 Vaisala WXT520
Meteorological stations**

**6 THIES-Clima Laser
Disdrometers**

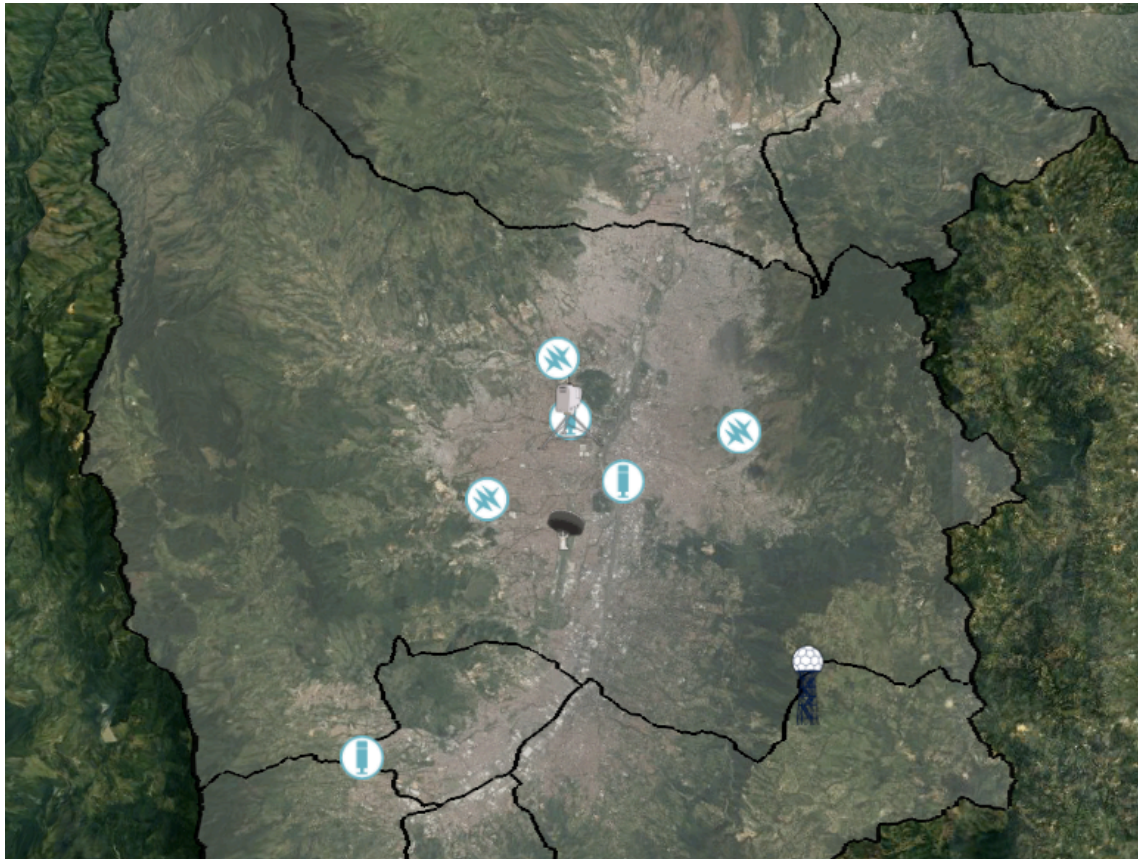
37 river level gauges

4 Pyranometers

1 UV sensor

1 OTT Pluvio rain gauge

Available Infrastructure



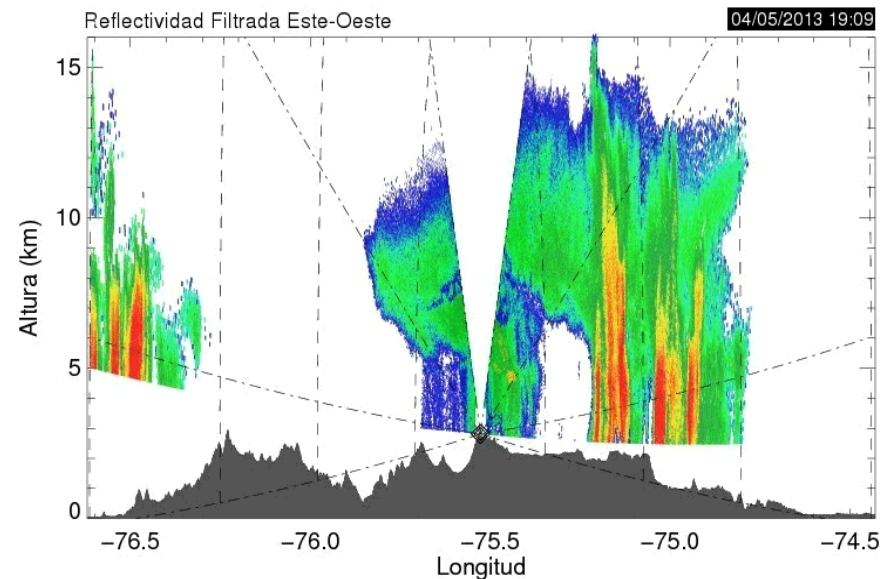
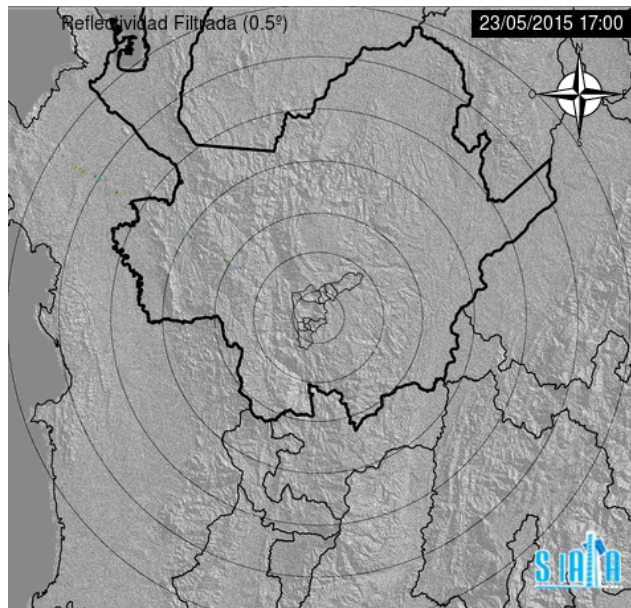
1 EEC C-Band Radar

**1 RADIOMETRICS
Microwave Radiometer**

1 DETECT BL wind profiler

3 VAISALA Ceilometers

CMED Radar

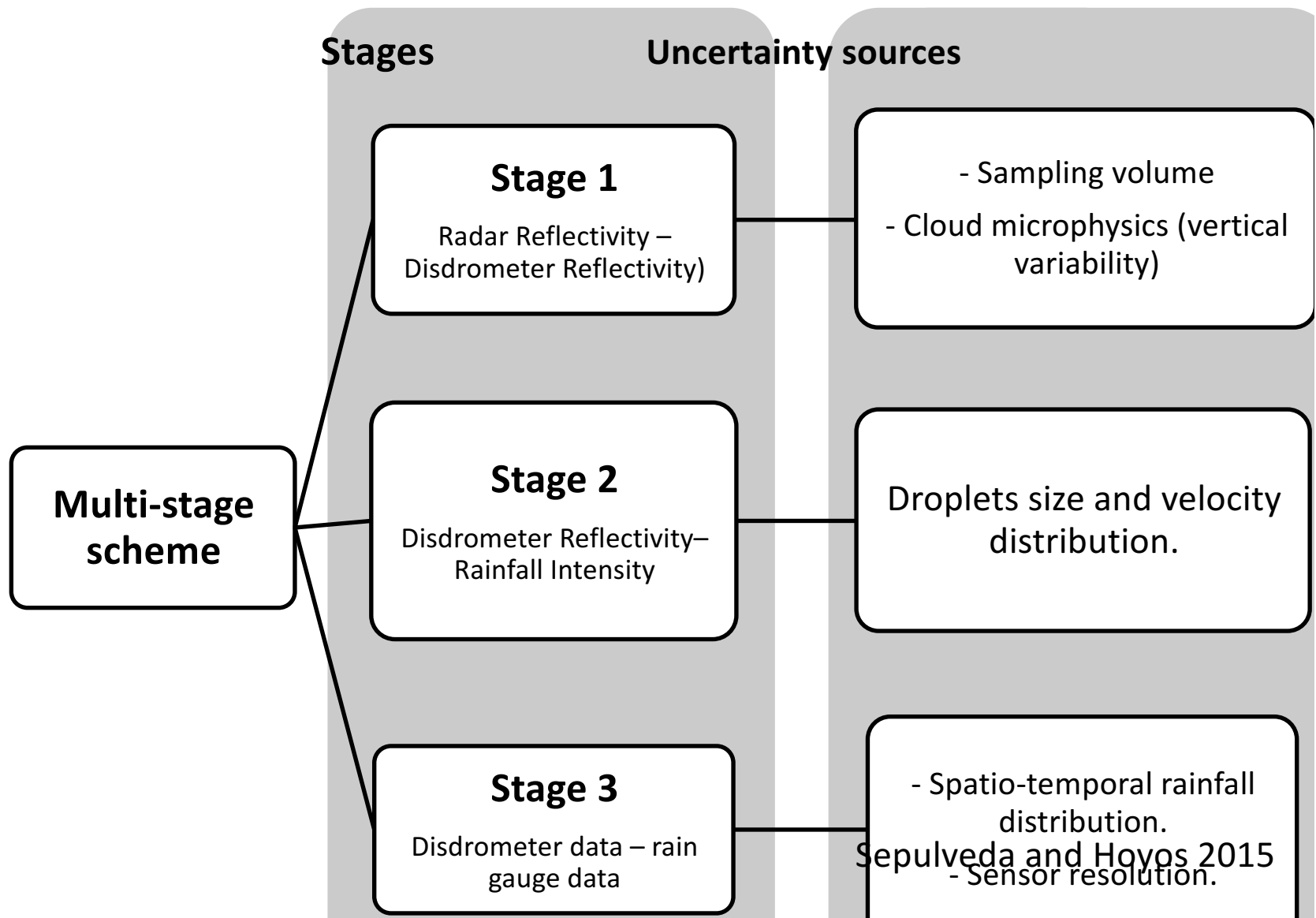


- Dual polarization, doppler C-Band radar, operating since 2012
- Operationally, the CMED radar scans the volume alternating every 5 min between **SUR** (4 elevations), and elevation angle scans (**RHI**) in 4 fixed azimuths (N, S, E, W)
- The only polarimetric radar that has been capturing fine vertical resolution scans (RHIs) for almost 4 years!!!

Radar Applications in Risk Management

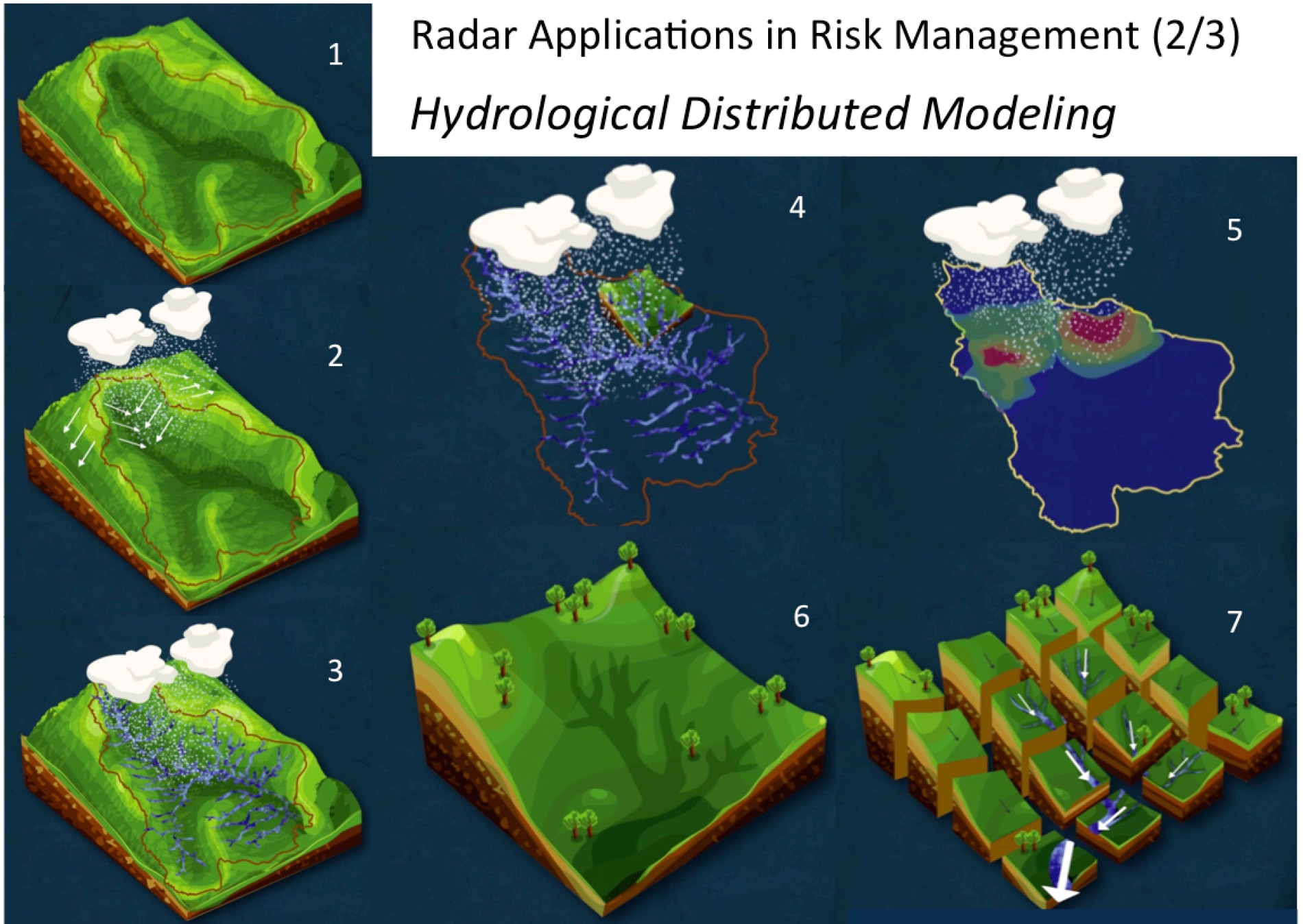
Radar Applications in Risk Management (1/3)

QPE: Quantitative precipitation estimation using radar reflectivities



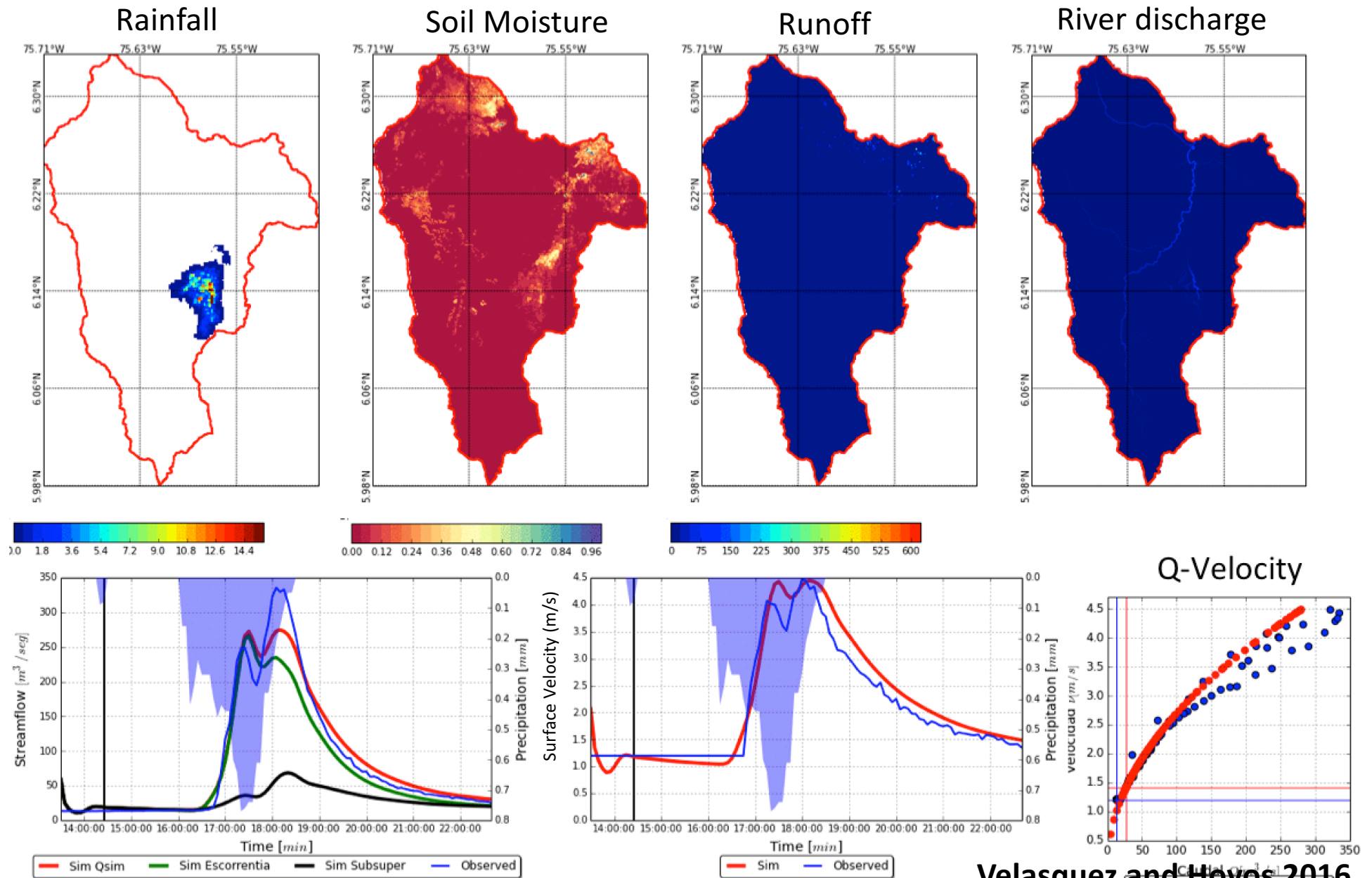
Radar Applications in Risk Management (2/3)

Hydrological Distributed Modeling



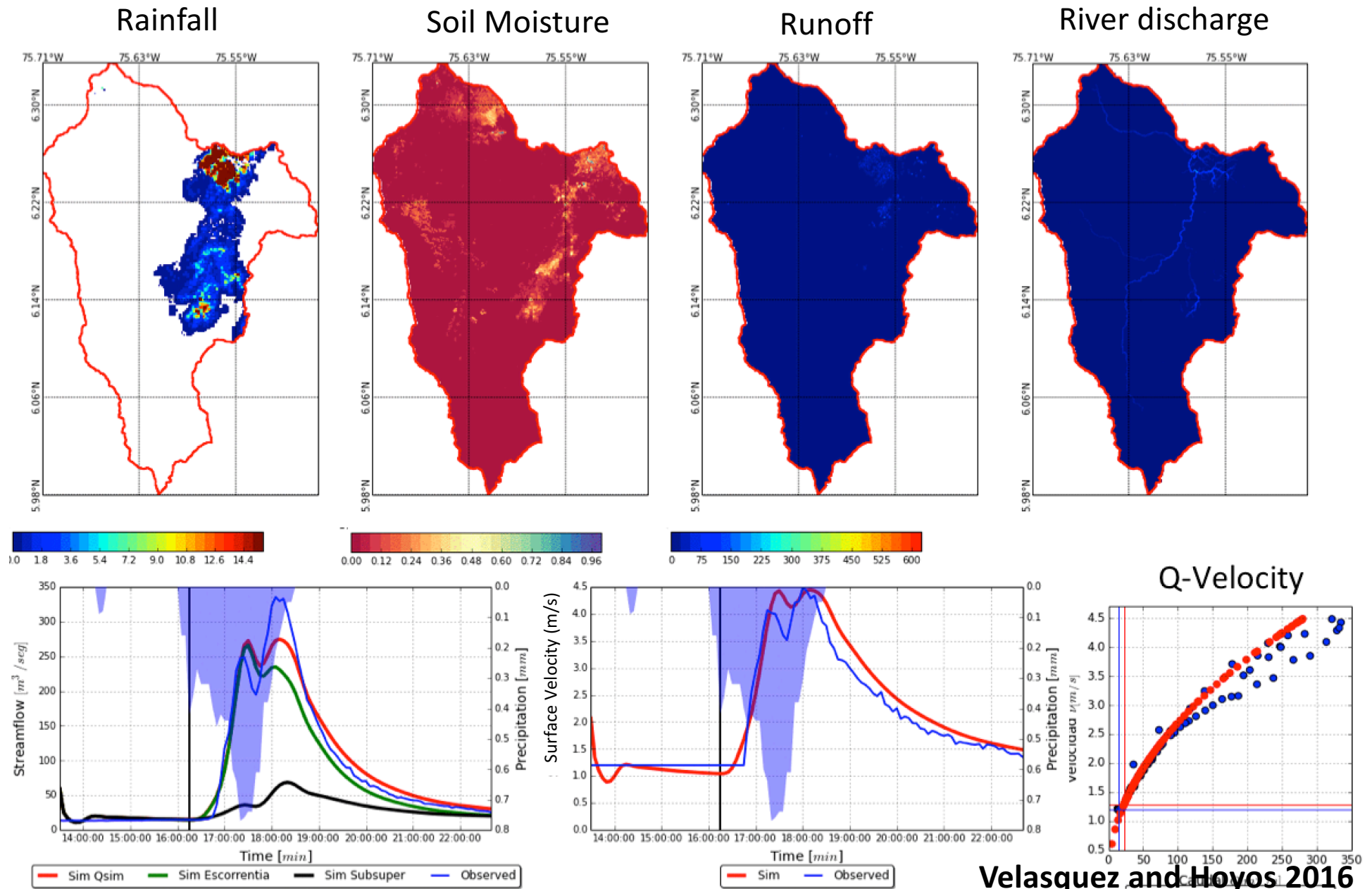
Velez 2001; Velasquez 2011

Hydrological Distributed Modeling using QPE from Radar



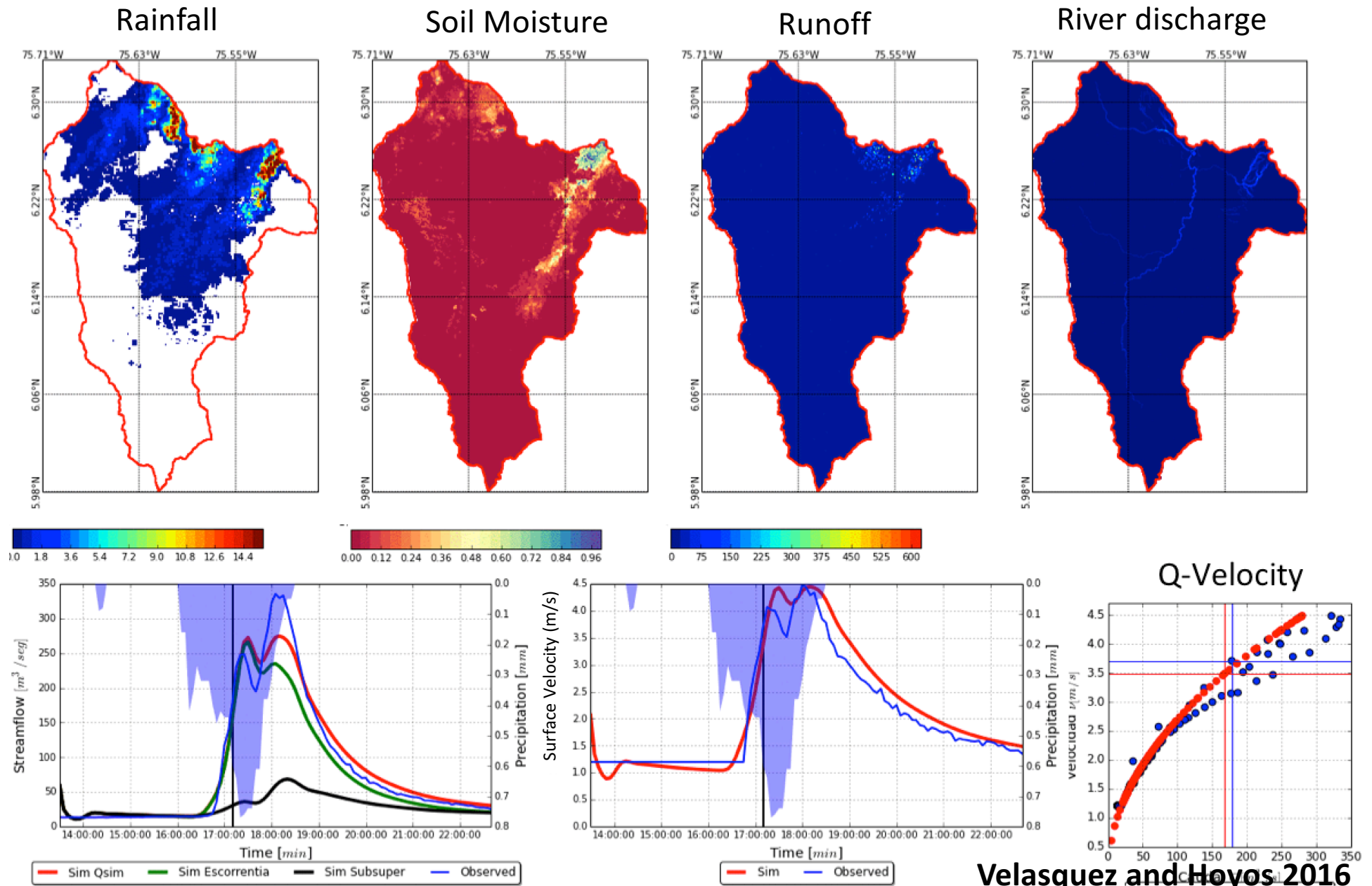
Velasquez and Hoyos 2016

Hydrological Distributed Modeling using QPE from Radar




Velasquez and Hoyos 2016

Hydrological Distributed Modeling using QPE from Radar



Velasquez and Hoyos 2016





QPE in Extreme Events: May 21, 2015


Regions » Colombia landslide kills dozens

International Edition + 🔍 menu ☰


Colombia landslide kills dozens

By Nelson Quiñones and [Catherine E. Shoichet](#), CNN
🕒 Updated 0202 GMT (1002 HKT) May 21, 2015








Top stories








Mosul assault: ISIS fighters fleeing to Syria



Spidey-strength: Aussie arachnid carts off mouse-sized snack



Conectando...



Story highlights

NEW: More than 80 people were killed, officials say

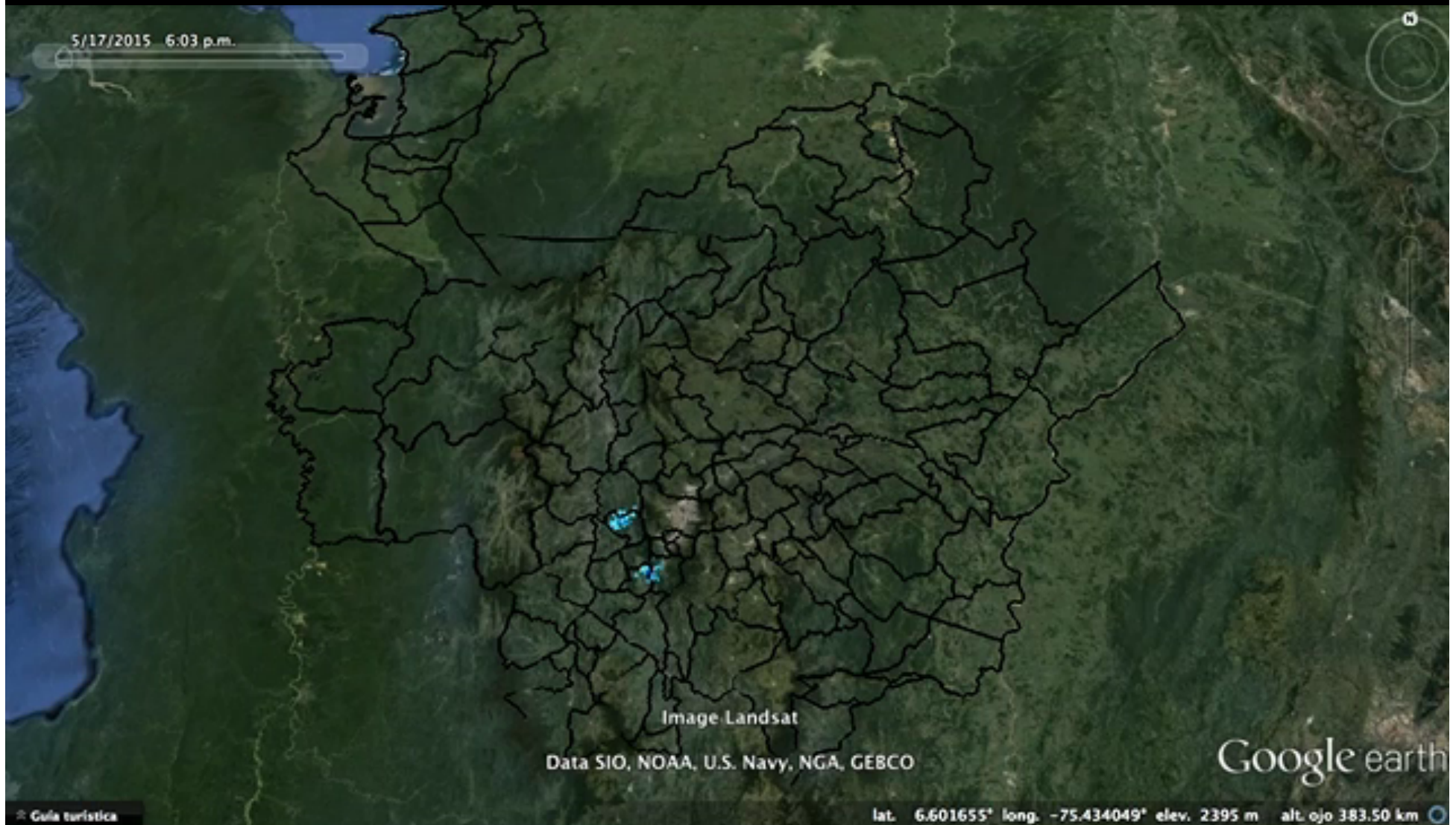
Survivor: After early morning landslide, "everything was gone"

Manuel Santos said.

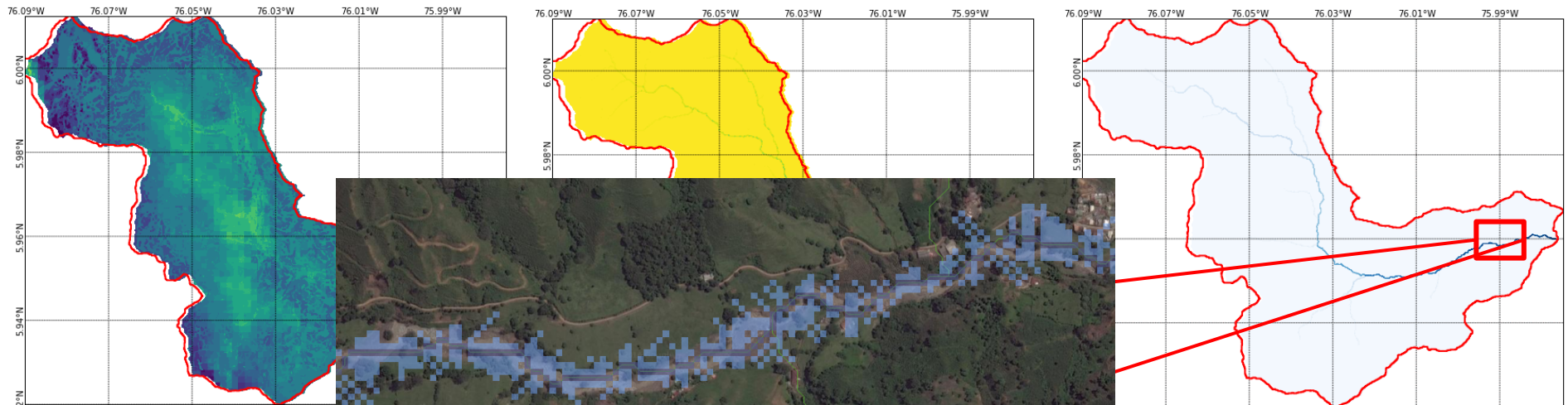
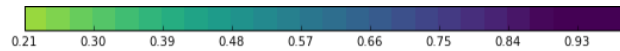
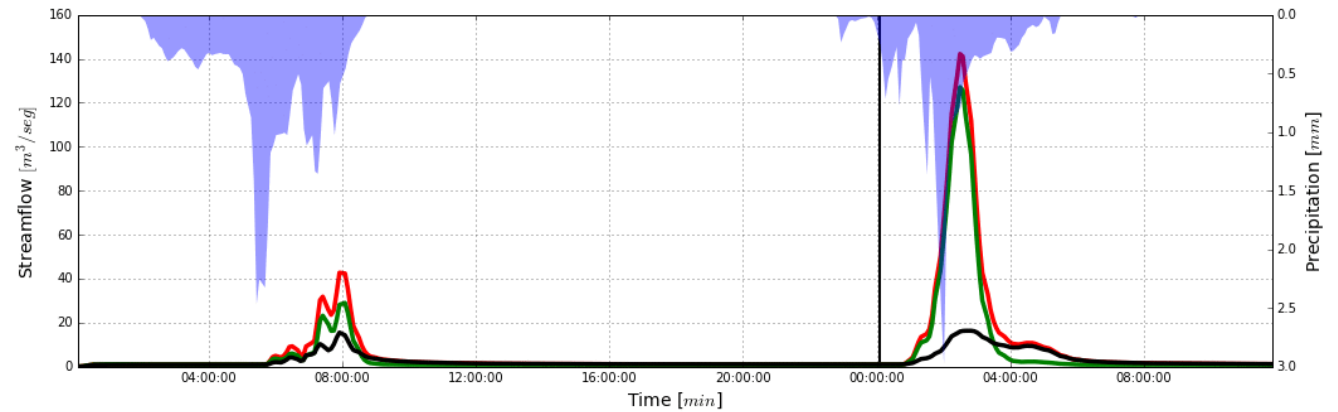
(CNN) — Heavy rains in northwest Colombia caused a landslide that killed more than 80 people as mud rushed into homes and bridges, officials said.

At least 37 people were injured in Monday's landslide in the municipality of Salgar, about 60 miles (100 kilometers) southwest of Medellin, President Juan

La Liboriana river, City of Salgar



Salgar Event: Hydrological Modelling (work in progress)

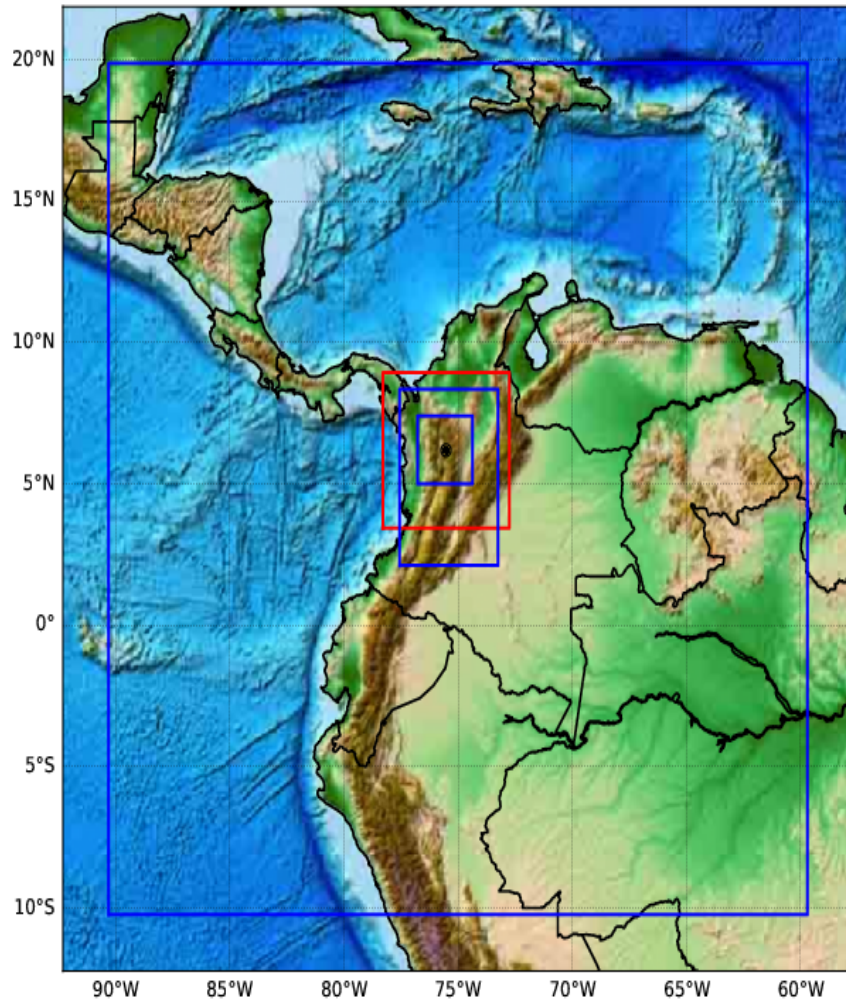


Soil Moisture ($S1 + S3$) / ($Hu + S3$)

Stream Velocity [m/s]

Radar Applications in Risk Management (3/3)

WRF-DA Operational Forecasting Using Data Assimilation



OPERATIONAL RUN

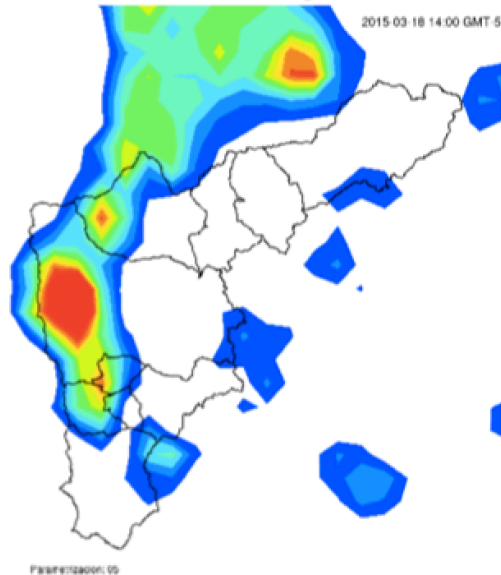
- 3 nested domains: 18, 6 and 2 km (blue boxes)
- 4 different microphysics parameterizations
- GFS boundary conditions: 0.5 deg, 12UTC
- Hourly outputs

DATA ASSIMILATION

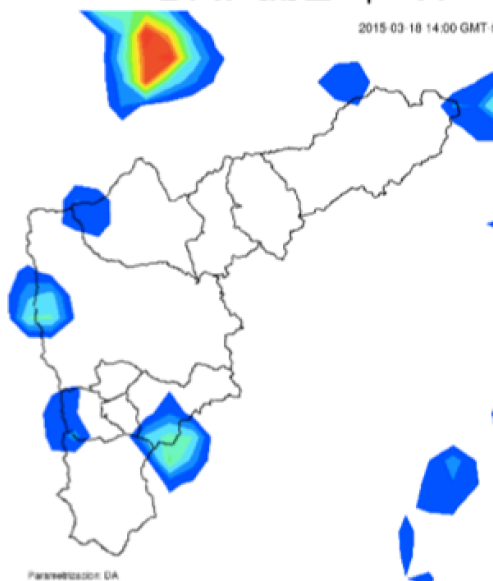
- Single 3 km domain (red box)
- 1 microphysics parameterization
- GFS boundary conditions: 0.25 deg, 12UTC
- 3DVAR
- Radar: both reflectivity and radial velocity from PPI scans (0.5, 1, 2, 4 elev). Data recorded around 1 hour of the initialization time is assimilated
- Radiometer: T and RH profiles. Data recorded around 1 hour of the initialization time is assimilated

2015-03-18 19UTC

CTRL 3km res



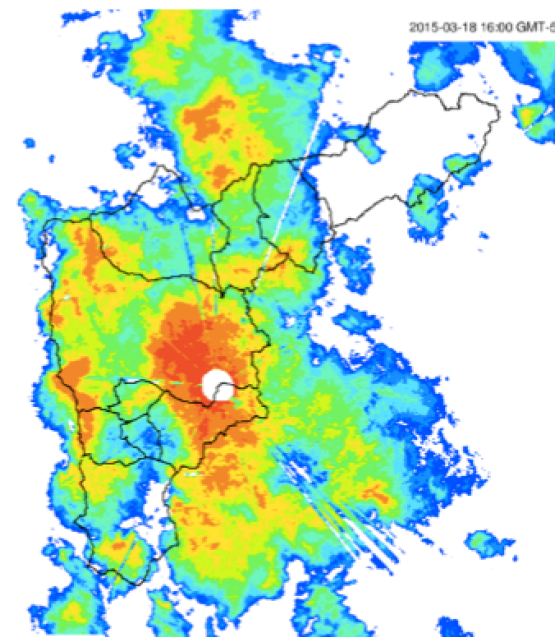
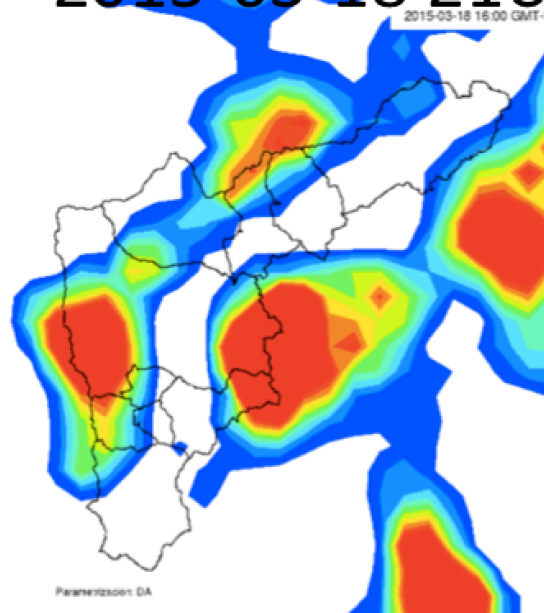
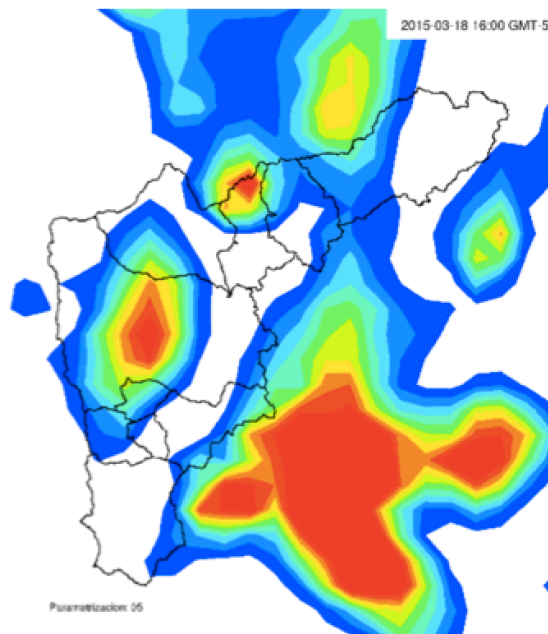
DA: dbZ + Vr



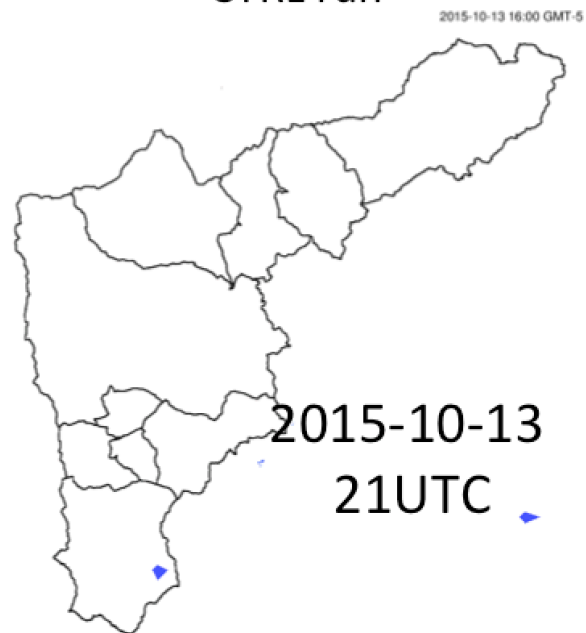
Radar obs



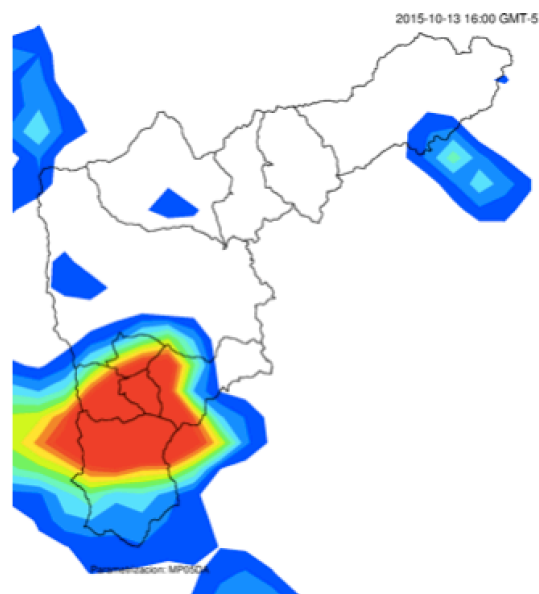
2015-03-18 21UTC



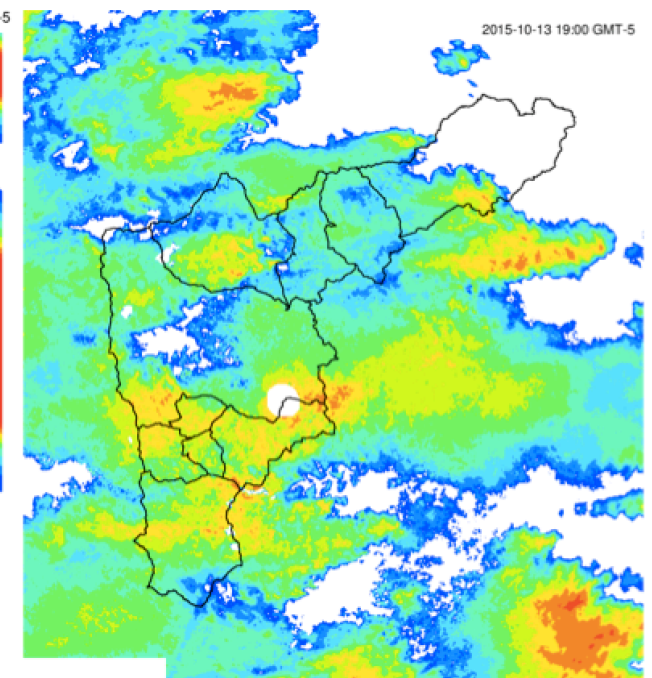
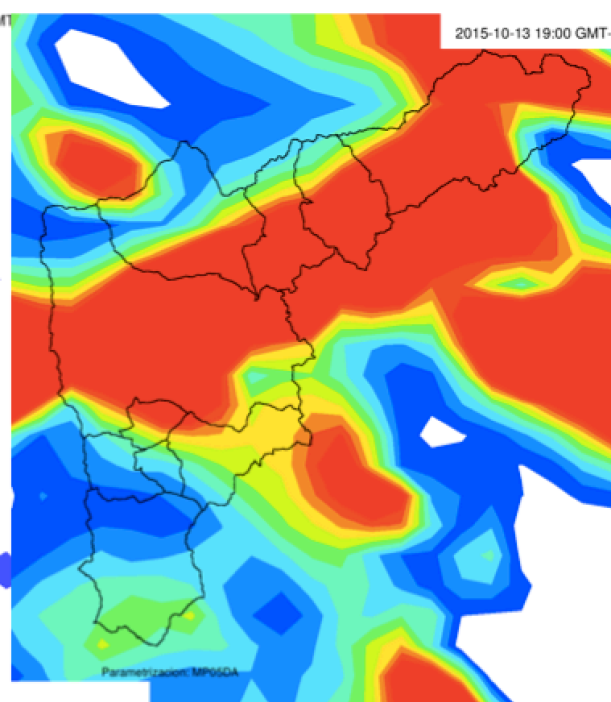
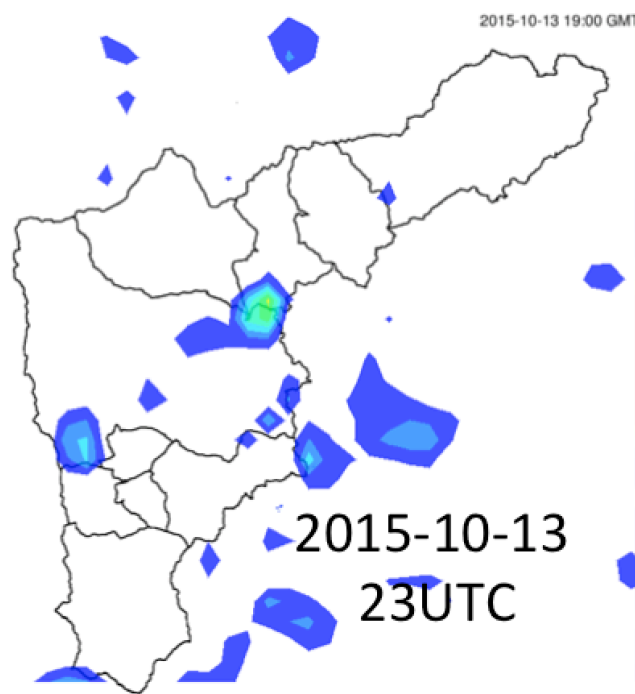
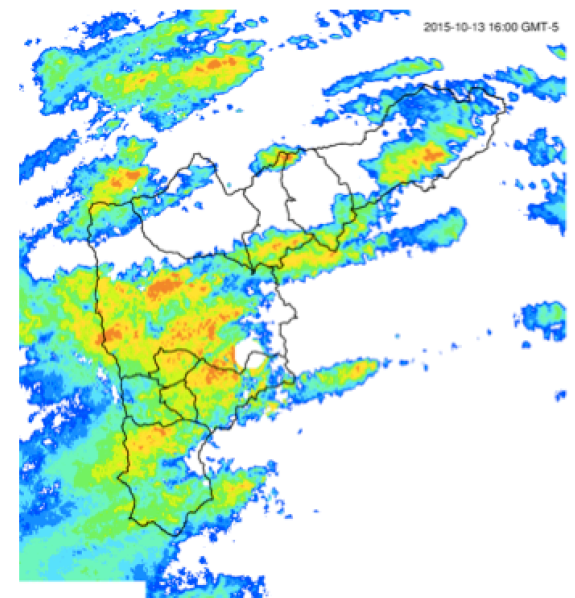
CTRL run



DA: dbZ + Vr



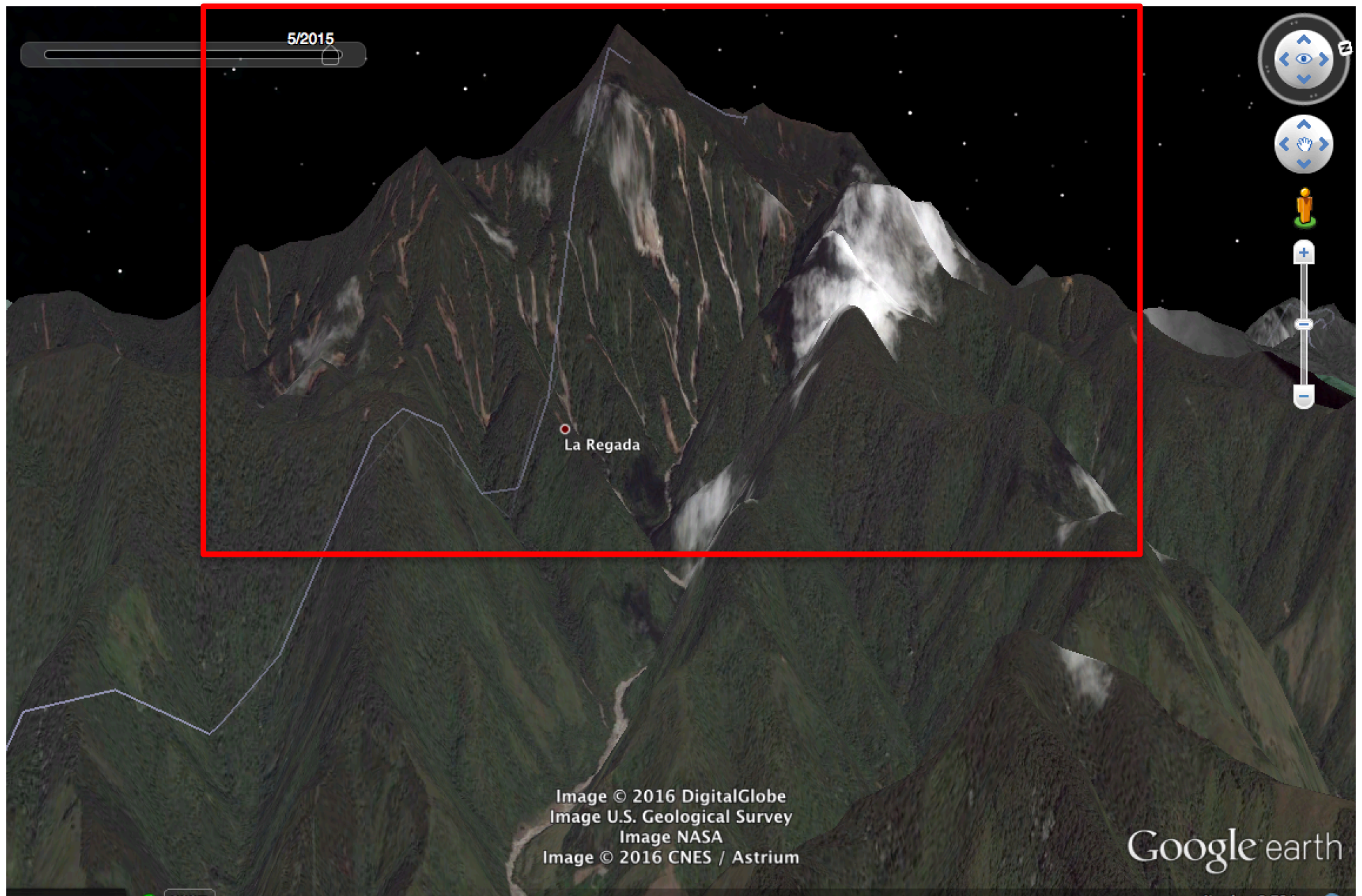
Radar Obs



Summary

- No-cost proposal to NASA
- Build a collaborative partnership between the NASA-PMM science team and SIATA
- Build a data-share framework to be used as a comparison and validation point,
 - Helping validation of the precipitation sensors aboard of the NASA satellites
 - Identification and contextualization of the weather and extreme precipitation events that occur over the region
- Learn from NASA experience in data collection and validation

Land-surface “scars” in the region of maximum cumulative rainfall





Sistema de Alerta Temprana de Medellín y el Valle de Aburrá
<http://www.siata.gov.co/>

- Science and technology project that aims to collect and produce reliable hydro-climatological information to provide early warnings to the city of Medellín, Colombia and their surroundings
- Project funded by local authorities that started in 2010
- Composed of more than ~35 individuals (Scientists, Engineers, Master and Undergrads students)

Con el apoyo de:



Un proyecto de:



Alcaldía de Medellín

*There is a need to improve the data collection
partnership by SIATA*